American Nuclear Society

Position Statement #30

Domestic Production of Stable and Radioactive Isotopes

The American Nuclear Society (ANS) supports a strong U.S. national policy that ensures a robust and resilient domestic supply of radioisotopes and stable isotopes adequate to sustain the growing needs of the U.S. health care, security, research, and industrial communities.

The ANS believes such policy includes the following elements:

(1) Reliability of supply.

(2) Public-private partnerships focused on new commercial production.

(3) Investments in critical infrastructure, research and development, and education and training.

(4) A balanced evaluation of the risks and benefits of non-radioisotope alternative technologies.

Overreliance on fragile, intercontinental supply chains or untrustworthy foreign suppliers can have devastating impacts on human lives and the U.S. economy. Reliability of supply can be improved through both an increased diversity of suppliers and a more balanced use of foreign supplies. Maturation of diverse and economic production capability for critical radioisotopes and stable isotopes is needed to promote commercial adoption.

Recognizing the federal government's essential role as a catalyst for nurturing a robust, diverse isotope supply chain, ANS supports Congressional funding for the Department of Energy's (DOE's) Isotope R&D and Production Program, which promotes activities necessary to bolster diverse supplies, such as viability studies, licensing support activities, and banking of isotopes. Programs like this support the government's obligation to spur new commercial production without interfering with, delaying, or competing with private sector efforts to supply isotopes.[1]

The U.S. must maintain and enhance critical infrastructure necessary to support the supply chain, such as the High Flux Isotope Reactor (HFIR), as well as conduct research into new production and processing techniques. As opportunities arise to upgrade capabilities at the nation's research and test reactors across universities and national laboratory facilities, the potential for new radioisotope production should be considered and incentivized where appropriate. ANS supports increased investment in isotope research and development as well as investing in training the next generation of the workforce necessary to meet future demands.

ANS acknowledges that for many applications, there are potential alternative technologies that may achieve the same objectives without relying on radiological sources.[2] These technologies may replace high-activity radioisotopes with machine-based radiation or eliminate the need for radiation altogether. If feasible, these technologies may reduce the risk of terrorists acquiring potentially dangerous radioactive materials. For example, X-ray devices may be used to irradiate blood, medical linear accelerators may be used to treat cancer, and electron beam–based technology may be used to sterilize agricultural products. In general, ANS supports the transition to alternative technologies where appropriate, but due consideration should be paid to the true costs of transition, the speed of implementation, the availability of infrastructure, and the unique capabilities or advantages of source-based systems.

Background

The use of radioactive isotopes has benefited society in many ways. In medicine, radioisotopes have been instrumental in diagnosing and treating disease, improving the lives of millions of people. In industry, radioisotopes allow for the analysis of material densities, inspection of critical systems, and product sterilization, as well as exploration of oil and gas reserves and detection of leaks in remote systems. Radioisotopes are also used by the Department of Homeland Security and the U.S. military for detecting trace amounts of explosives, narcotics, chemical warfare agents, and industrial chemicals. Also, fundamental research to understand the physical and chemical properties of heavier elements involves the use of radioisotopes.

The vast majority of radioactive isotopes used in medicine, industry, security, and research are produced by irradiating materials with neutrons in nuclear reactors. The HFIR is an important source of medical radioisotopes, including actinium-227. The reactor was started in 1965, and the DOE is planning to replace its pressure vessel, implement upgrades, and convert it from the use of high-enriched uranium to low-enriched uranium fuel.[3] The aging of this critical infrastructure will impact our nation's ability to produce radioactive isotopes. Government support is needed for new research and test reactors that have radioisotope production as one of their main missions.

The potential consequences of shortages of radioisotopes have been well documented in reports and hearings before Congress. Every year in the U.S, doctors perform more than 40 million medical procedures that rely on the use of medical isotopes. Additionally, countless nondestructive tests of pipelines and other infrastructure are performed with radioisotopes. The demand by academic and commercial researchers for access to the DOE's HFIR and other major U.S. neutron sources is higher than current facilities can accommodate. This means that promising research, especially in the field of cancer treatment, have been delayed, postponed, or abandoned because of the unavailability of certain radioisotopes.

The DOE has established a national radioisotope program in the Office of Science. Under the direction of the Nuclear Science Advisory Committee (NSAC), Isotopes Subcommittee, a long-range plan was issued in July 2015 for the DOE Office of Science's Office of Nuclear Physics Isotope Program entitled *Meeting Isotope Needs and Capturing Opportunities for the Future*.[1] The DOE has made substantial progress in improving isotope production infrastructure at U.S. national laboratories and at U.S. universities. This has enhanced availability of research and non-commercial isotopes for U.S. stakeholders through the National Isotope Development Center.

Before 2009, the DOE depended on national laboratory facilities to provide certain commercial isotopes and research isotopes. Under an expanded approach since 2009, the DOE has engaged over a dozen sites in production and distribution. The DOE's incorporation of U.S. university cyclotrons and university research reactors into their network either directly or through collaboration has expanded research isotope availability and extended the capability of the existing accelerator network. For example, Missouri University, the University of Washington, the University of Wisconsin, Duke University, Washington University, and the University of California–Davis are involved in supplying research isotopes.

The 2015 long-range plan encourages the continued collaboration with existing facilities and expansion to other U.S. university accelerators and research reactors where possible. Several universities are also supplying commercial sources or producing radioisotopes that are not readily available from commercial suppliers. Continued public-private collaboration that does not compromise either the DOE Isotope Program or the current university production and distribution network may be challenging but will be important to maintaining and improving the availability of key isotopes. Furthermore, as commercial vendors start producing and selling isotopes that are currently a major part of the DOE sales portfolio, the DOE will need to judge the effects on the long-term business model of the Isotope Program.

The responsibility to produce certain isotopes does not reside with the DOE Isotope Program. The DOE National Nuclear Security Administration is responsible for the conversion of the commercial production of molybdenum-99 (the parent isotope of technetium-99m) away from processes using high-enriched uranium and for improving the reliability of the U.S. domestic supply of molybdenum-99. ANS supports efforts toward the elimination of civilian utilization of high-enriched uranium in medical isotope production.[4]

Enriched stable isotopes are used as target materials that produce both stable and radioactive beams. For example, fluorine-18 is produced with a cyclotron using oxygen-18—a stable, naturally occurring isotope of oxygen—as a target. As another example, calcium-48, a neutron-rich stable isotope, is used to study the properties of other elements. Scientists also discover new elements using similar isotopes. These types of experiments require actinide targets, including isotopes of uranium, neptunium, plutonium, americium, curium, californium, and berkelium. Research in actinide chemistry also is important for environmental studies regarding the effective disposal of nuclear waste.

One of the DOE NSAC's 2009 recommendations[5] for the Isotope Program was the establishment of effective, full-intensity operations of the stable isotope separation capability at Oak Ridge National Laboratory, and much progress has been made toward this goal. This facility will provide a reliable U.S. source of high-purity stable isotopes, many of which are currently available only from foreign suppliers. Adequate and sustained funds are needed to fully establish the program, to support operations of this new capability, and to improve the efficiency of the isotope separators.

References

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2. *Radioactive Sources: Applications and Alternative Technologies. National Academies of Sciences, Engineering, and Medicine*. 2021. https://doi.org/10.17226/26121.

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4. American Nuclear Society Position Statement #72: "The Use of Highly Enriched Uranium for the Production of Medical Isotopes." January 2022. https://cdn.ans.org/policy/statements/docs/ps72.pdf.

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